REMARKS

Claims 1-77 are now pending in the application. Claims 1, 4, 7, 13, 19, 25, 27, 32, 38, 43, 44, 46, 51, 53, 60, 63, 65, 68, and 69 are amended hereby. New claims 75-77 are added hereby.

Claims 1, 6, 7, 22, 23, 26, 27, 43, 51, and 60 were previously amended by Applicants in the Amendment filed August 19, 2004. New claims 62-74 were added by Applicants in the Amendment filed August 19, 2004.

The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein and in the Amended filed August 19, 2004.

REJECTION UNDER 35 U.S.C. § 102

Claims 1, 43-47, 49-53, and 56-59 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Lotz (U.S. Pat. No. 4,856,735). This rejection is respectfully traversed.

At the outset, Applicants submit that the amendments to independent claims 1, 43, and 51 have rendered moot the section 102 rejections of claim 1, claim 43 (and claims 44-47, 49, and 50 depending therefrom), and claim 51 (and claims 52, 53, and 56-59 depending therefrom). Applicants further submit that the inventions set forth in claims 1, 43-47, 49-53, and 56-59 are patentably distinct over Lotz for at least the reasons set forth below.

Independent claims 1, 43, and 51 have each been amended to clarify that the slot has a predetermined three-dimensional shape tailored to improve transonic performance over an un-slotted wing. This is not disclosed, taught, or even remotely suggested by Lotz. Indeed, Lotz does not go beyond the two-dimensional aspects of an airfoil. For example, Lotz does not specifically address the three-dimensional shape of the slot or the airfoil for that matter.

Because Lotz does not at least disclose a slot having a three-dimensional shape tailored to improve transonic performance over an un-slotted wing, Lotz cannot anticipate claims 1, 43-47, 49-53, and 56-59. For at least this reason, the Patent Office is respectfully requested to reconsider and withdraw the section 102 rejections of the claims 1, 43-47, 49-53, and 56-59.

With regard to dependent claims 44-47, 49, 52-53, and 56-59, these claims each depend from a claim shown above to be allowable. Accordingly, Applicants respectfully submit that claims 44-47, 49, 52-53, and 56-59 are also allowable for allowance for at least the reasons given above in connection with the independent claim from which it depends.

REJECTION UNDER 35 U.S.C. § 103

Claims 2-42, 48, 54-55, and 60-61 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lotz (U.S. Pat. No. 4,856,735) in view of Kelley-Wickemeyer (U.S. Pat. No. 6,293,497). This rejection is respectfully traversed.

Applicants submit that the amendments to claims 6, 7, 22, and 60 have rendered moot the section 103 rejections of claim 6, claim 7, claim 22 (and claims 23-42 depending therefrom), and claim 60 (and claim 61 depending therefrom). Applicants further submit that the inventions set forth in the pending claims are patentably distinct over Lotz in view of Kelley-Wickemeyer for at least the following reasons.

Independent claims 22 and 60 have each been amended to clarify that the airfoil/wing has a predetermined three-dimensional shape tailored to improve transonic performance over an un-slotted wing, and that the slot has a predetermined three-dimensional shape to allow a portion of the air flowing along the lower surface of the leading airfoil element to diverge to flow over the upper surface of the trailing airfoil element and, thereby, to provide the performance improvement. These features do not appear to be disclosed, taught or suggested by either Lotz or Kelley-Wickemeyer, alone or in combination. Indeed, Lotz does not go beyond the two-dimensional aspects of an airfoil. For example, Lotz does not specifically address the three-dimensional shape of the slot or the airfoil for that matter.

Further, Lotz focuses on specifying general curvature levels in certain regions of an airfoil without regard to details about a three-dimensional airfoil/wing at a given flight condition. While Lotz appears to suggest locating the slot behind the shock, Lotz provides little to no rationale for the slot's positioning or shaping, which the inventors of the present application have realized can be relatively significant in order to achieve a performance gain. In this regard, various preferred implementations of the present invention utilize a full three-dimensional wing pressure distribution and address shock location and sweep by specifically tailoring the wing geometry so as to pull the shock back as close as possible to the slot location and controlling any subsequent re-expansions through shaping as well as positioning of the flap(s). As noted in the specification, preferred implementations included specific rules and guidelines that were developed for applying computational fluid dynamics modeling to achieve these goals.

Because the cited references do not disclose, teach or suggest an airfoil/wing or a slot having a predetermined three-dimensional shape tailored to improve transonic performance over an un-slotted wing, claims 2-42, 48, 54-55, and 60-61 are not rendered obvious by Lotz in view of Kelley-Wickemeyer. For at least this reason, the Patent Office is respectfully requested to reconsider and withdraw the section 103 rejections of the claims 2-42, 48, 54-55, and 60-61.

With regard to dependent claims 2-21, 23-42, 48, 54-55, and 61, these claims each depends from a claim shown above to be allowable. Accordingly, Applicants respectfully submit that claims 2-21, 23-42, 48, 54-55, and 61 are allowable for at least the reasons given above in connection with the independent claim from which it depends.

In addition, the dependent claims are further patentably distinguishable over Lotz in view of Kelley-Wickemeyer because these patents do not disclose, teach or suggest the additional features required by the dependent claims, such as:

> "the slot only extends spanwise from about a planform break of the wing to about a tip of the wing" (as recited in claim 6); or
>
> "the slot only extends over a portion of the wing where airflow separation would occur to add drag during a transonic condition of the wing" (as recited in claim 7); or
>
> "the slot includes a plurality of segments longitudinally arranged along the wing, each of the segments being independently adjustable by the actuator structure to allow trimming of the slot differently at different locations along the span" (as recited in claim 14); or

"at least one un-slotted wing region disposed between two slotted wing regions" (as recited in claim 18); or

"the slot only extends spanwise from about a planform break of the wing to about a tip of the wing" (as recited in claim 26); or

"the slot only extends over a portion of the wing where airflow separation would occur to add drag during a transonic condition of the wing" (as recited in claim 27); or

"the slot includes a plurality of segments longitudinally arranged along the wing, each of the segments being independently adjustable by the actuator structure to allow trimming of the slot differently at different locations along the span" (as recited in claim 33); or

"the at least one partial-span slot comprises a plurality of partial-span slots longitudinally arranged along the wing" (as recited in claim 35); or

"at least one un-slotted wing region disposed between two slotted wing regions" (as recited in claim 37).

With further regard for claims 14 and 33, these claims each require "the slot includes a plurality of segments longitudinally arranged along the wing, each of the segments being independently adjustable by the actuator structure to allow trimming of the slot differently at different locations along the span." While Lotz discloses a flow gap that is selectively settable, Lotz does not disclose or teach a plurality of slots as required by claims 14 and 33. And, Kelley-Wickemeyer appears to teach away from the use of independently adjustable slots during transonic conditions in that Kelley-Wickemeyer teaches a first slot that is permanently open for all flap positions, and a second slot that is present for takeoff and landing but closed during other flight conditions.

CLAIMS 62-77

Claims 62-74 were added by the Amendment filed August 19, 2004. Claims 75-77 are added hereby. Claims 62-77 are supported by the application as originally filed. Accordingly, no new matter is introduced by the addition of claims 62-77.

In addition, claims 62-68 and 75-77 each depend from an independent claim shown above to be allowable. Accordingly, Applicants respectfully submits that claims 62-68 and 75-77 are each in condition for allowance for at least the reasons given above in connection with the independent claim from which they depend. That is, none of the cited references disclose, teach or suggest an airfoil/wing or a slot having a predetermined three-dimensional shape tailored to improve transonic performance over an un-slotted wing.

In addition, claims 75-77 are further patentably distinguishable over the cited references in that the cited references do not disclose, teach or suggest the additional features required by claims:

> "slot location substantially coincides with shock location" (as recited in claims 62 and 64); or
>
> "the slot is located along the span only at the position where the airfoil experiences Mach critical flow" (as recited in claims 63 and 65); or
>
> "the slot comprises a plurality of partial-span slots longitudinally arranged along the wing, and wherein the method further comprises independently trimming each said slot during the transonic condition so as to achieve a performance improvement in the transonic condition" (as recited in claims 66 and 67); or
>
> "the slot comprises a plurality of partial-span slots longitudinally arranged along the wing, and wherein the method further comprises independently trimming each said slot during cruise so as to achieve a performance improvement during cruise" (as recited in claim 68); or
>
> "the three-dimensional shape of the airfoil is tailored in accordance with three-dimensional airfoil pressure distribution data including information related to three-dimensional shock location and sweep of the airfoil" (as recited in claims 75 and 76); or
>
> "the airfoil has a pressure distribution corresponding to that shown in the figures" (as recited in claim 77).

Further, claims 69-74 are patentably distinguishable over the cited references in that the cited references do not disclose, teach or suggest a method that includes "tailoring a swept wing's three-dimensional geometry using three-dimensional wing pressure distribution data including information related to three-dimensional shock location such that the wing defines at least one spanwise slot that allows a portion of the air flowing along a lower surface of the wing to diverge to flow over an upper surface of the wing during at least one transonic condition of the wing so as to achieve a performance improvement in the transonic condition".

As mentioned above, Lotz does not go beyond the two-dimensional aspects of airfoil design. Lotz does not specifically address three-dimensional wing pressure distribution or three-dimensional shock location. Lotz also does not address tailoring wing geometry and spanwise extent of a slot in accordance with a wing's three-dimensional pressure distribution. Further, Lotz focuses on specifying general curvature levels in certain regions of an airfoil without regard to the detailed three-dimensional pressure distribution over a three-dimensional airfoil at a given flight condition. While Lotz appears to suggest locating the slot behind the shock, Lotz provides little to no rationale for the slot's positioning or shaping, which the inventors of the present application have realized can be relatively significant in order to achieve a performance gain. In this regard, various preferred implementations of the present invention utilize a full three-dimensional wing pressure distribution and address shock location and sweep by specifically tailoring the wing geometry so as to pull the shock back as close as possible to the slot location and controlling any subsequent re-expansions through shaping as well as positioning of the flap(s). As noted in the specification, preferred implementations included specific rules and guidelines that were developed for applying computational fluid dynamics (CFD) modeling to achieve these goals. This CFD modeling can allow airflows and their effects on the airfoil/wing to be mathematically predicted in a cost-effective manner.

In addition, claims 75-77 are further patentably distinguishable over the cited references in that the cited references do not disclose, teach or suggest the additional features required by claims:

"the tailoring includes locating the slot substantially coincident with shock location" (as recited in claim 70); or

"obtaining the three-dimensional wing pressure distribution data by computational modeling" (as recited in claim 71); or

"obtaining the three-dimensional wing pressure distribution data by simulating an airflow over the wing using three-dimensional computational fluid dynamics" (as recited in claim 72); or

"the tailoring includes locating the slot where the three-dimensional computational fluid dynamics simulated airflow suggests that a pressure field will result in airflow separation on the upper surface of the wing" (as recited in claim 73); or

"determining where the wing will become Mach number critical, and wherein the tailoring includes locating the slot only where it has been determined that the wing will become Mach number critical" (as recited in claim 74).

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested.

Applicants believe that the appropriate fees are included herewith. The Patent Office is hereby authorized, however, to charge Deposit Account No. 08-0750 for any additional fees or to credit any overpayments thereto.

If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (314) 726-7502.

Respectfully submitted,

Dated: September 16, 2004

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